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MEMORANDUM

TO: Mr. Timothy O'Connor
Trammell Crow Residential, Inc.
160 Gould Street
Suite 121
Needham, MA 02494

FROM: Mr. Jeffrey S. Dirk, P.E., PTOE
Vanasse & Associates, Inc.
10 New England Business Center Drive
Suite 314
Andover, MA 01810-1066
(978) 474-8800

DATE: April 24, 2007

RE: 4984

SUBJECT: Proposed Residential Development
48 Old Powdermill Road
Concord, Massachusetts

COMMONWEALTH OF MASSACHUSETTS JEFFREY S. DIRK No. 33971 CIVIL REGISTERED PROFESSIONAL ENGINEER 4/27/07

Vanasse & Associates, Inc. (VAI) has completed an initial Traffic Impact Assessment (TIA) in order to determine the traffic impacts associated with the construction of a 350-unit residential apartment community to be located at 48 Old Powdermill Road in Concord, Massachusetts, with access to the proposed site being located in Acton, Massachusetts. This assessment reviews the anticipated traffic characteristics of the proposed project and provides a comprehensive assessment of operating conditions and safety on the transportation infrastructure serving the project site, both with and without the planned development. The study was conducted in general accordance with state standards for the preparation of TIAs and was performed in consultation with the Towns of Acton, Concord and Maynard, and the Massachusetts Highway Department (MassHighway). A review of the analysis completed as a part of this assessment indicates that the planned development will not result in a significant impact on traffic operations or safety within the study area over existing or anticipated future conditions without the project. The following summarizes our findings.

PROJECT DESCRIPTION

The proposed project will consist of the construction of a 350-unit residential apartment community to be located on a 25±-acre parcel of land generally bounded by commercial properties to the north and east; and residential properties, municipal land and private properties to the south and west. The project site currently contains two commercial buildings and associated parking areas and appurtenances that will be removed in conjunction with the planned development. Access to the proposed project will be provided by way of Old Powdermill Road, a public way within the Town of Acton that intersects the northeast side of Sudbury Road immediately adjacent to the Acton-Maynard Town Line and south of Route 62, in Acton, Massachusetts. Figure 1 depicts the site location in relation to the existing roadway network.

EXISTING CONDITIONS

A comprehensive field inventory of traffic conditions on the study area roadways was conducted in December 2006. The field investigation consisted of an inventory of existing roadway geometrics, traffic volumes, and operating characteristics, as well as posted speed limits and land use information within the study area. The initial study area for the project was selected to contain the major roadways providing access to the development including Powdermill Road (Route 62), High Street and Sudbury Road, as

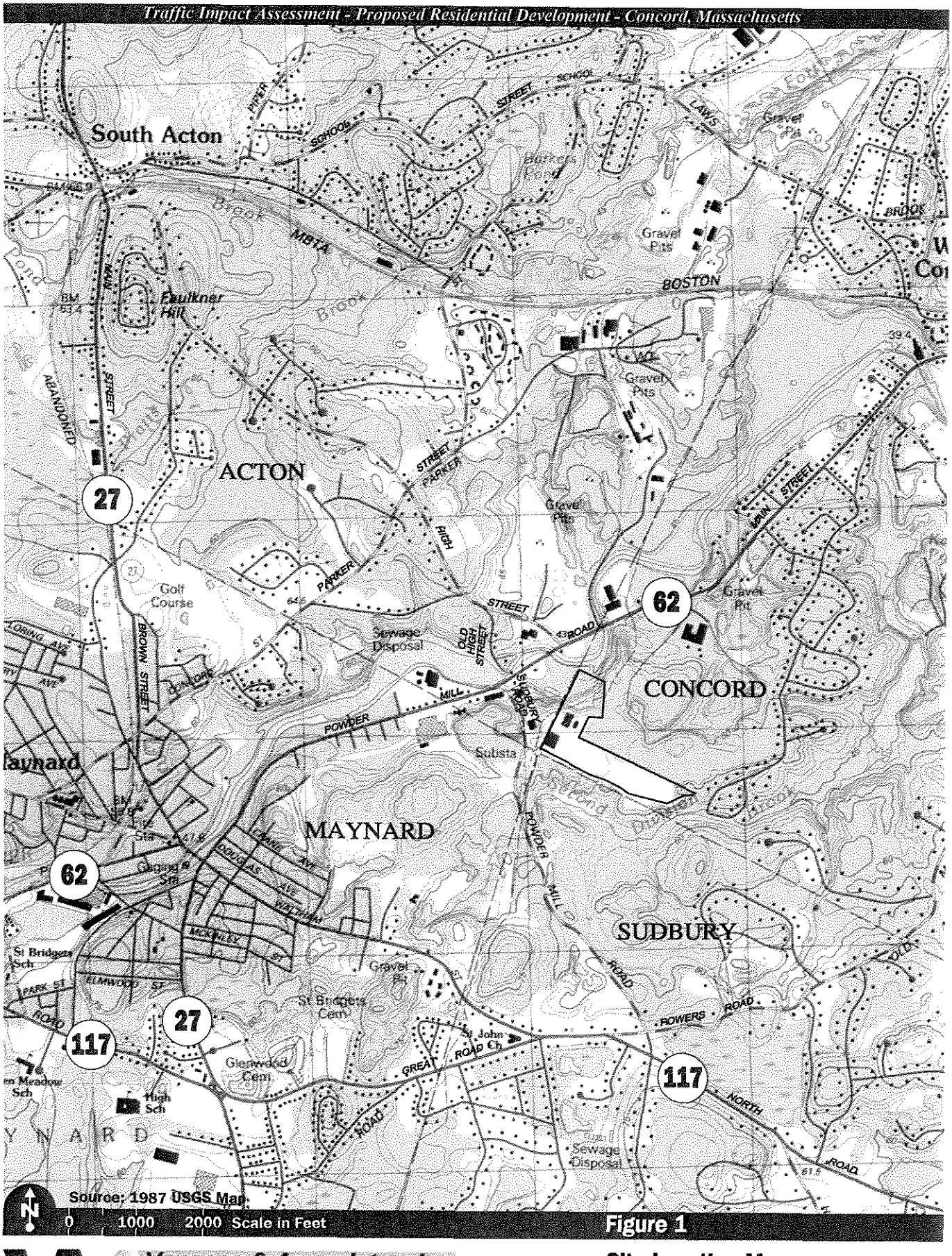

Figure 1

Site Location Map

Vanasse & Associates, Inc.
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well as the intersections of Powdermill Road (Route 62) at High Street; Route 62 at Sudbury Road; High Street at Parker Street; and Sudbury Road at Old Powdermill Road. The following describes the study area roadways and intersections.

GEOMETRY

Roadways

Powdermill Road (Route 62)

Powdermill Road (Route 62) is a two-lane urban principal arterial roadway under local jurisdiction that traverses the study area in a general northeast-southwest direction. Within the study area, Route 62 provides two 12- to 15-foot wide travel lanes separated by a double-yellow centerline, with 1- to 3-foot wide marked shoulders provided, and additional turning lanes provided at major intersections. Sidewalks are provided intermittently along the south side of Route 62 within the study area. Illumination is provided by way of street lights mounted on wood poles. Land use along Route 62 consists of the Assabet River, commercial properties, and areas of open and wooded space.

High Street

High Street is a two-lane urban collector roadway under local jurisdiction that traverses the study area in a general northwest-southeast direction between Route 27 and Route 62. Within the study area, High Street provides two 12- to 13-foot wide travel lanes separated by a double-yellow centerline, with variable width or no marked shoulders provided, and additional turning lanes provided at major intersections. Sidewalks are provided intermittently along the northeast side of High Street within the study area. Illumination is provided by way of street lights mounted on wood poles. Land use along High Street consists of commercial and residential properties.

Sudbury Road

Sudbury Road is a two-lane minor roadway under local jurisdiction that traverses the study area in a general northwest-southeast direction between Route 62 and Route 117. Sudbury Road becomes Powdermill Road in the Town of Sudbury. Within the study area, Sudbury Road varies in width between 18 and 28-feet (paved area), and accommodates two-way travel with no marked centerline or shoulders provided. In general, sidewalks are not provided along Sudbury Road, with illumination provided intermittently by way of street lights mounted on wood poles. Land use along Sudbury Road consists of the project site, commercial and residential properties, and areas of open and wooded space.

Intersections

Powdermill Road (Route 62) at High Street

High Street intersects Powdermill Road (Route 62) from the northwest to form this three-legged, T-type intersection under traffic signal control. The Route 62 northeastbound approach consists of a 13-foot wide left-turn lane and a 12-foot wide through travel lane, with a 1-foot wide marked shoulder provided. The Route 62 southwestbound approach consists of a 12-foot wide through travel lane and a 12-foot wide right-turn lane, with a 1-foot wide marked shoulder provided. The directions of travel along Route 62 are separated by a double-yellow centerline. The High Street southeastbound approach consists of 11.5-foot wide left and right-turn lanes (two-lane approach), with a 1-foot wide marked shoulder provided. Sidewalks are provided along the south side of Route 62, west of High Street, and along the east side of High Street. Marked crosswalks are provided across the west leg of Route 62 and across High Street. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of commercial properties. The traffic signal operates in a three-phase, fully-actuated mode, with an eastbound advance phase provided for Route 62. An exclusive pedestrian phase is proivided upon pushbutton actuation.

Route 62 at Sudbury Road

Sudbury Road intersects Route 62 from the south to form this three-legged, T-type, unsignalized intersection under STOP-sign control. The Route 62 northeast and southwestbound approaches consist of a 13- to 13.5-foot wide general purpose travel lane, with 2.5- to 3-foot wide marked shoulders provided. The directions of travel along Route 62 are separated by a double-yellow centerline. The Sudbury Road south leg of the intersection consists of a 28-foot wide paved roadway that accommodates two-way travel, with no marked centerline or shoulders provided, and vehicles approaching Route 62 under STOP-sign control. A sidewalk is provided along the north side of Sudbury Road approaching Route 62. A marked crosswalk is provided for crossing Sudbury Road that is situtaed to the south of Route 62. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of the Assabet River and commercial properties.

High Street at Parker Street

Parker Street intersects High Street from the northeast and southwest, respectively, to form this four-legged intersection under STOP-sign control. The High Street north and southbound approaches consist of a 12- to 13-foot wide general purpose travel lane, with no marked shoulder provided. The directions of travel along High Street are separated by way of a double-yellow centerline. The Parker Street northeastbound approach consists of a 13.5-foot wide left-turn/through travel lane under STOP-sign control, with right-turns exiting prior to the intersection by way of

a channelized right-turn slip-ramp that is also under STOP-sign control. The Parker Street southwestbound approach consists of a 12.5-foot wide general purpose travel lane, with a no marked shoulder provided, and vehicles approaching High Street under STOP-sign control. The directions of travel along Parker Street are separated by way of a double-yellow centerline. Sidewalks are not provided at the intersection. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of residential properties.

Sudbury Road at Old Powdermill Road

Old Powdermill Road intersects Sudbury Road from the east to form this three-legged, Y-type, unsignalized intersection under YIELD-sign control. The Sudbury Road north and south legs of the intersection consist of an 18 to 21-foot wide paved roadway, respectively, that accomodate two-way travel, with no marked centerline or shoulders provided. The Old Powdermill Road leg of the intersection consists of a 24-foot wide paved roadway that accomodates two-way travel, with no marked centerline or shoulders provided, and vehciles approaching Sudbury Road under YIELD-sign control. Sidewalks are not provided at the intersection. Illumination provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of the project site, commercial and residential properties, and areas of open and wooded space.

Existing Traffic Volumes

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in December 2006. The ATR counts were conducted on Sudbury Road, north of Old Powdermill Road, in order to record weekday daily traffic conditions in the vicinity of the project site over an extended period. The TMCs were conducted at the study intersections during the weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak periods.

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, historic traffic count data were reviewed for the nearest MassHighway permanent count station to the project site.[1] Based on a review of this data, it was determined that traffic volumes for the month of December are approximately 4.4 percent below average-month conditions. In accordance with state standards for the preparation of TIAs, the December traffic volumes were adjusted upward by 4.4 percent in order to reflect average-month conditions within the study area. The 2006 Existing weekday morning and evening peak-hour traffic volumes are depicted on Figures 2 and 3, respectively, and are summarized in Table 1.

[1] MassHighway Traffic Volumes for the Commonwealth of Massachusetts; Permanent Count Station 403 located on Route 2, east of the Concord Rotary in Concord; 2005.

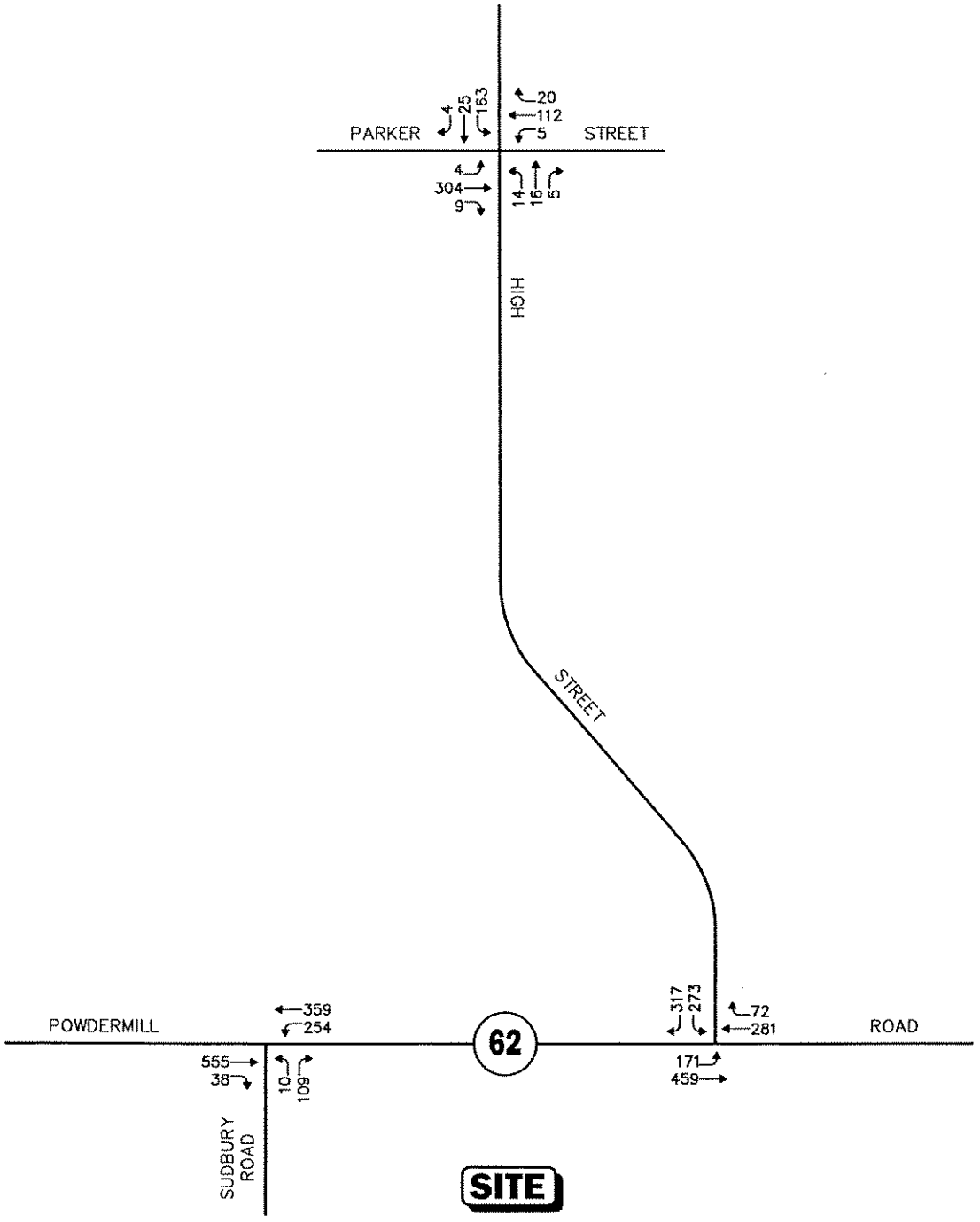

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Figure 2

2006 Existing
Weekday Morning
Peak Hour Traffic Volumes

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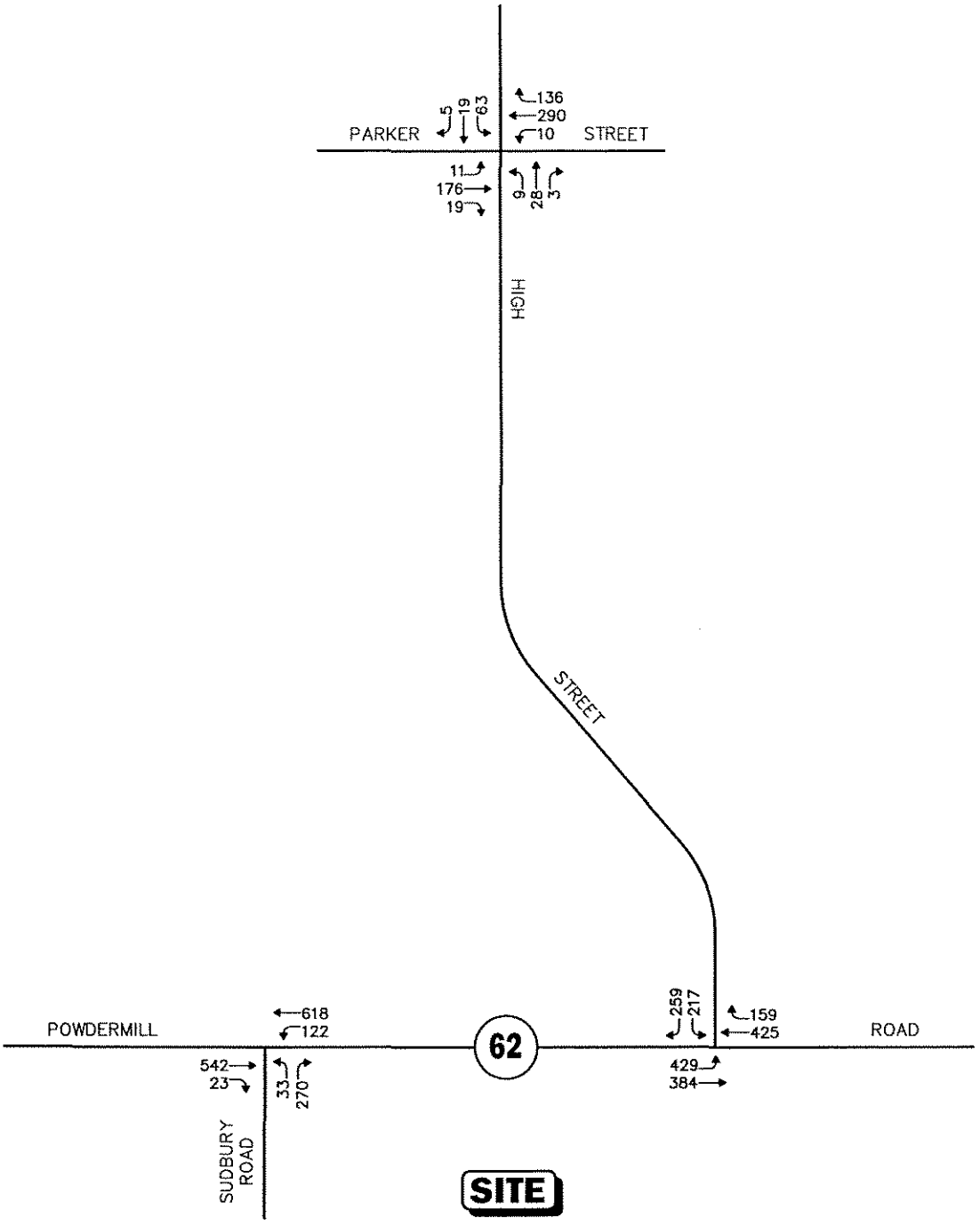

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Figure 3

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2006 Existing Weekday Evening Peak Hour Traffic Volumes

Table 1
2006 EXISTING TRAFFIC VOLUMES

Location	AWT[a]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		VPH[b]	K Factor[c]	Directional Distribution[d]	VPH	K Factor	Directional Distribution
Sudbury Road, north of Old Powdermill Road	3,990	411	10.3	71.0% SEB	448	11.2	67.6% NWB

[a]Average weekday traffic in vehicles per day.
[b]Vehicles per hour.
[c]Percent of daily traffic occurring during the peak hour.
[d]Percent traveling in peak direction.
SEB = southeastbound; NWB = northwestbound.

As can be seen in Table 1, Sudbury Road, north of Old Powdermill Road, was found to accommodate approximately 3,990 vehicles on an average weekday, with approximately 411 vehicles per hour (vph) during the weekday morning peak hour and 448 vph during the weekday evening peak hour.

A review of the peak-period traffic counts indicates that the weekday morning peak hour generally occurs between 7:15 and 8:15 AM, with the weekday evening peak hour generally occurring between 4:00 and 5:00 PM.

Speed Measurements

Vehicle travel speed measurements were performed over a continuous 24-hour period on Sudbury Road in the vicinity of the project site using a pneumatic speed measuring device (ATR). Table 2 summarizes the vehicle travel speed measurements.

Table 2
VEHICLE TRAVEL SPEED MEASUREMENTS

	Sudbury Road	
	Northeastbound	Southwestbound
Mean Travel Speed (mph)	23	24
85th Percentile Speed (mph)	28	28
Posted Speed Limit (mph)	--	--

mph = miles per hour.

As can be seen in Table 2, the mean (average) vehicle travel speed along Sudbury Road in the vicinity of the project site was found to be approximately 24 mph. The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 28 mph. The 85th percentile vehicle travel speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

Motor Vehicle Crash Data

Motor vehicle crash information for the study area intersections was provided by the MassHighway Safety Management/Traffic Operations Unit for the most recent three-year period available (2003 through 2005) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, pavement condition, and day of occurrence, and presented in Table 3.

Table 3
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Route 62/ High Street	Route 62/ Sudbury Road	High Street/ Parker Street
Year:			
2003	4	1	8
2004	0	0	2
2005	3	1	4
Total	7	2	14
Average	2.33	0.67	4.67
Rate[b]	0.31	0.10	1.50
Significant?[c]	No	No	Yes
Type:			
Angle	4	1	12
Rear-End	3	0	0
Head-On	0	0	1
Sideswipe	0	1	0
Unknown	0	0	1
Total	7	2	14
Day of Week:			
Monday through Friday	6	2	9
Saturday	1	0	2
Sunday	0	0	3
Total	7	2	14
Severity:			
Property Damage Only	5	2	8
Personal Injury	2	0	6
Fatal	0	0	0
Total	7	2	14
Lighting:			
Daylight	7	2	12
Dark (Road Lit)	0	0	1
Other/Unknown	0	0	1
Total	7	2	14

[a]Source: MassHighway Safety Management/Traffic Operations Unit records, 2003 through 2005.
[b]Crash rate per million vehicles entering the intersection.
[c]The intersection crash rate is significant if it is found to exceed 0.63 crashes per million vehicles entering the intersection for unsignalized intersections and 0.88 crashes per million vehicles entering the intersection for signalized intersections as defined by MassHighway for the MassHighway District in which the project is located (District 4).

As can be seen on Table 3, the study area intersections were found to have experienced approximately 5 or fewer reported motor vehicle crashes over the three-year review period. The intersection of High Street at Parker Street was found to have experienced the highest number of motor vehicle crashes of the three study intersections, with a total of 14 crashes reported over the three year review period. The majority of the crashes occurring at this intersection involved property damage only (8 out of 14), occurred on a weekday (9 out of 14), involved angle-type collisions (12 out of 14), and occurred under daylight conditions (12 out of 14). The intersection of High Street at Parker Street was also found to have a motor vehicle crash rate above the MassHighway average for unsignalized intersections for the MassHighway District in which the intersection is located (District 4). In and of itself, this does not necessarily indicate that a specific safety deficiency exists at the subject intersection; however, the data does suggest that a more detailed safety evaluation should be conducted at the intersection based on information provided by the Town of Acton Police Department. The detailed motor vehicle crash records for the intersection of High Street at Parker Street have been requested from the Town and will be evaluated once the data is received. The remaining study intersections were found to have a motor vehicle crash rate below the MassHighway District 4 average for signalized or unsignalized intersections, as appropriate. No fatal motor vehicle crashes were reported at the study intersections over the three-year review period. The detailed MassHighway Crash Rate Worksheets are provided in the Appendix.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2012, which reflects a five-year planning horizon from the current year (2007) consistent with state traffic study standards. Independent of the proposed project, traffic volumes on the roadway network in the year 2012 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated project-generated traffic volumes superimposed upon this 2012 No-Build traffic network reflect 2012 Build conditions with the project.

Specific Development by Others

MassHighway and the Planning Departments of the Towns of Acton, Concord and Maynard were contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes in the vicinity of the project site. Based on these discussions, the following projects were identified:

- ***Proposed 129 Parker Street Redevelopment, Maynard, Massachusetts.*** This proposed project consists of the redevelopment of an existing 550,000 sf office complex located at 129 Parker Street, in Maynard, Massachusetts. Traffic volumes expected to be generated by this project were obtained from the traffic study conducted by VAI for the development[2] and assigned onto the study area roadway network based on existing traffic patterns.

No other projects were identified at this time that would impact future traffic volumes within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassHighway from historic traffic counts in the area were reviewed in order to determine general traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the Towns of Acton, Concord and Maynard have fluctuated over the past several

[2] *Traffic Impact and Access Study*, Proposed 129 Parker Street Redevelopment, Maynard, Massachusetts; VAI; October 2006.

years, ranging from increases of approximately 2.4 percent to decreases of approximately 2.5 percent. On average, historic traffic volumes within the study area were found to have remained relatively stable over the past 10-years. In order to account for future traffic growth and presently unforeseen development within the study area, a 1.0 percent per year compounded annual background traffic growth rate was used.

Roadway Improvement Projects

MassHighway and the Towns of Acton and Concord were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, no roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

No-Build Traffic Volumes

The 2012 No-Build condition peak-hour traffic-volume networks were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2006 Existing peak-hour traffic volumes and then superimposing the peak-hour traffic volumes expected to be generated by the previously identified specific development by others. The resulting 2012 No-Build condition weekday morning and evening peak-hour traffic-volume networks are shown on Figures 4 and 5, respectively.

Project-Generated Traffic

Design year (2012 Build) traffic volumes for the study area roadways were determined by estimating project-generated traffic volumes and assigning these volumes on the study roadways. The following sections describe the procedures used to develop the Build condition traffic-volume networks.

The proposed project will entail the construction of a 350-unit residential apartment community. In order to develop the traffic characteristics of the proposed project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)[3] for a similar land use as that proposed were used. ITE Land Use Code (LUC) 220, Apartment, with the independent variable of number of dwelling units equal to 350, was used to develop the traffic characteristics of the planned residential development. Table 4 summarizes the anticipated traffic characteristics of the proposed project.

[3] *Trip Generation,* Seventh Edition; Institute of Transportation Engineers; Washington, DC; 2003.

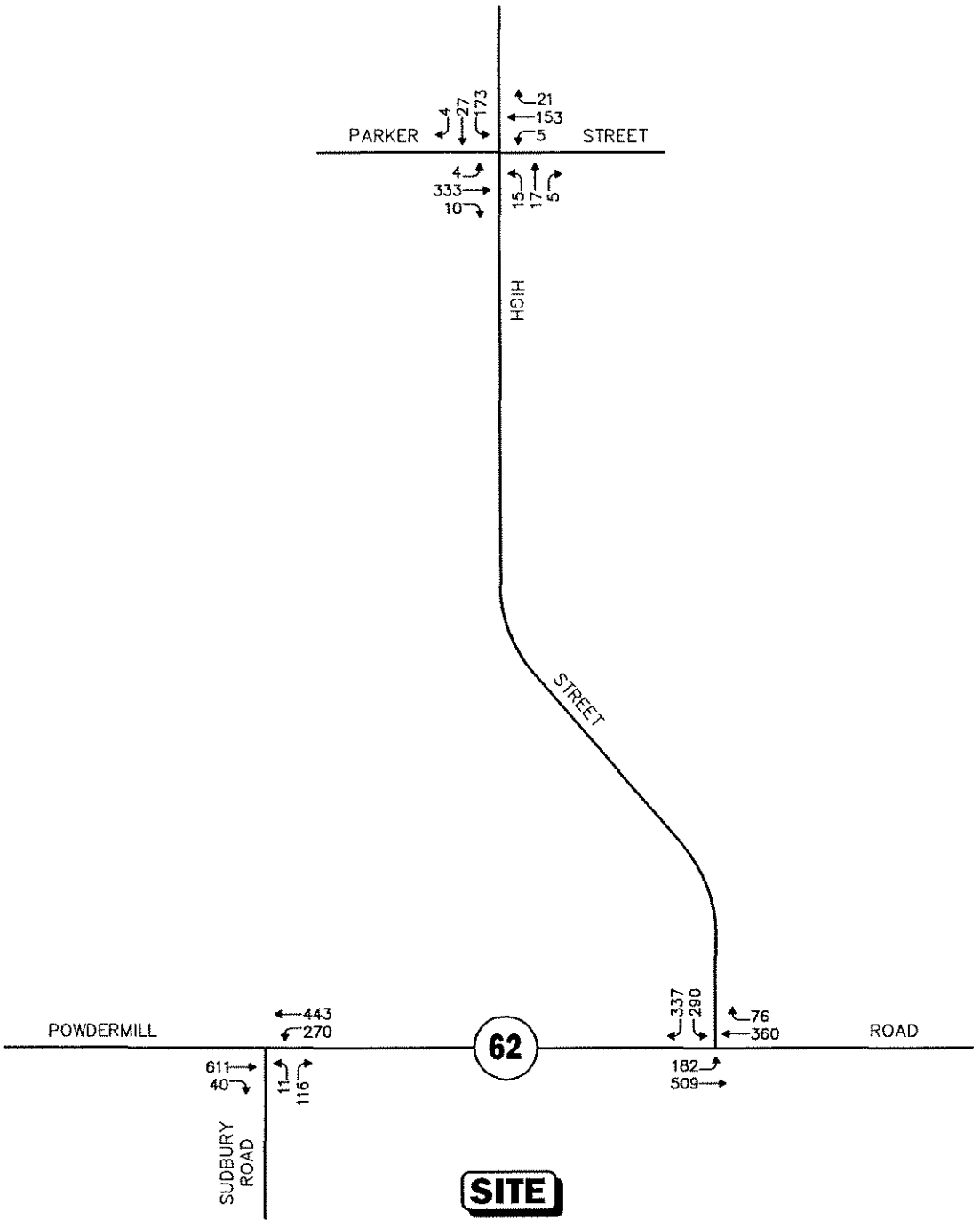

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Figure 4

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2012 No-Build
Weekday Morning
Peak Hour Traffic Volumes

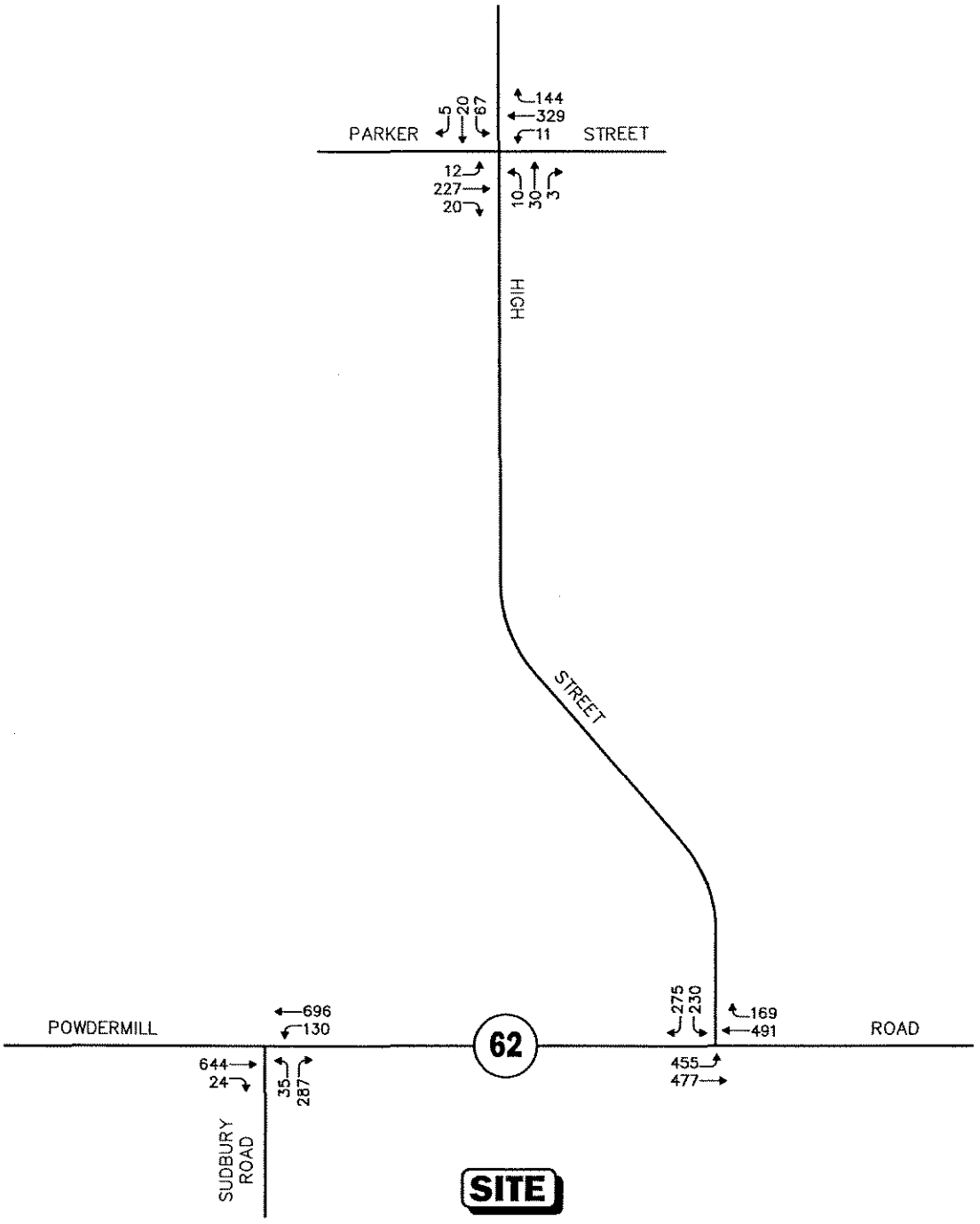

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Figure 5

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2012 No-Build
Weekday Evening
Peak Hour Traffic Volumes

Table 4
TRIP-GENERATION SUMMARY

Time Period/Direction	Vehicle Trips (A) Proposed Residential Community (350 Units)[a]
Average Weekday Daily	2,254
Weekday Morning Peak Hour:	
Entering	35
Exiting	140
Total	175
Weekday Evening Peak Hour:	
Entering	137
Exiting	73
Total	210

[a]Based on ITE LUC 220 – Apartment.

As can be seen in Table 4, the proposed development is expected to generate approximately 2,254 vehicle trips on an average weekday (1,127 entering and 1,127 exiting), with approximately 175 vehicle trips (35 entering and 140 exiting) during the weekday morning peak hour and 210 vehicle trips (137 entering and 73 exiting) during the weekday evening peak hour.

Trip Distribution and Assignment

The directional distribution of generated trips to and from the proposed development was determined based on a review of existing travel patterns along the study area roadways and at the study intersections during the commuter peak periods. This methodology is reflective of the residential nature of the proposed development and commuter traffic patterns during the peak periods. In general, 45 percent of project-related traffic was assigned to/from the northeast on Route 62, with 25 percent oriented to/from the southwest on Route 62, 15 percent to/from the northeast on Parker Street, and 15 percent to/from the southeast on Sudbury Road. The anticipated trip distribution pattern for the project is graphically depicted on Figure 6. The additional weekday morning and evening peak-hour traffic volumes expected to be generated by the proposed residential community were assigned on the study area roadway network as shown on Figures 7 and 8.

Future Traffic Volumes – Build Condition

The 2012 Build condition networks consist of the 2012 No-Build traffic volumes with the anticipated project-generated traffic added to them. The 2012 Build condition weekday morning and evening peak-hour traffic-volume networks are graphically depicted on Figures 9 and 10, respectively.

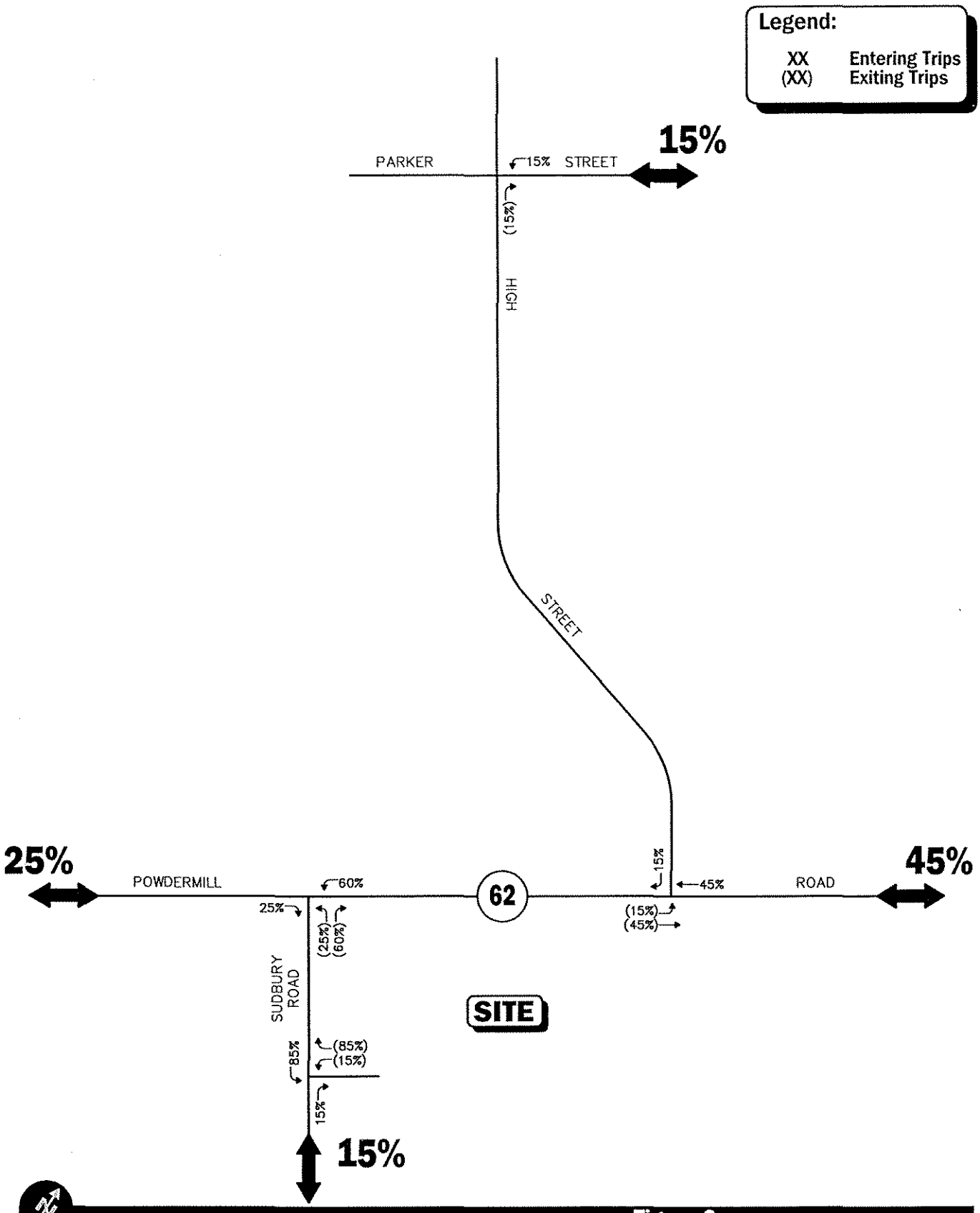

Figure 6

Trip Distribution Map

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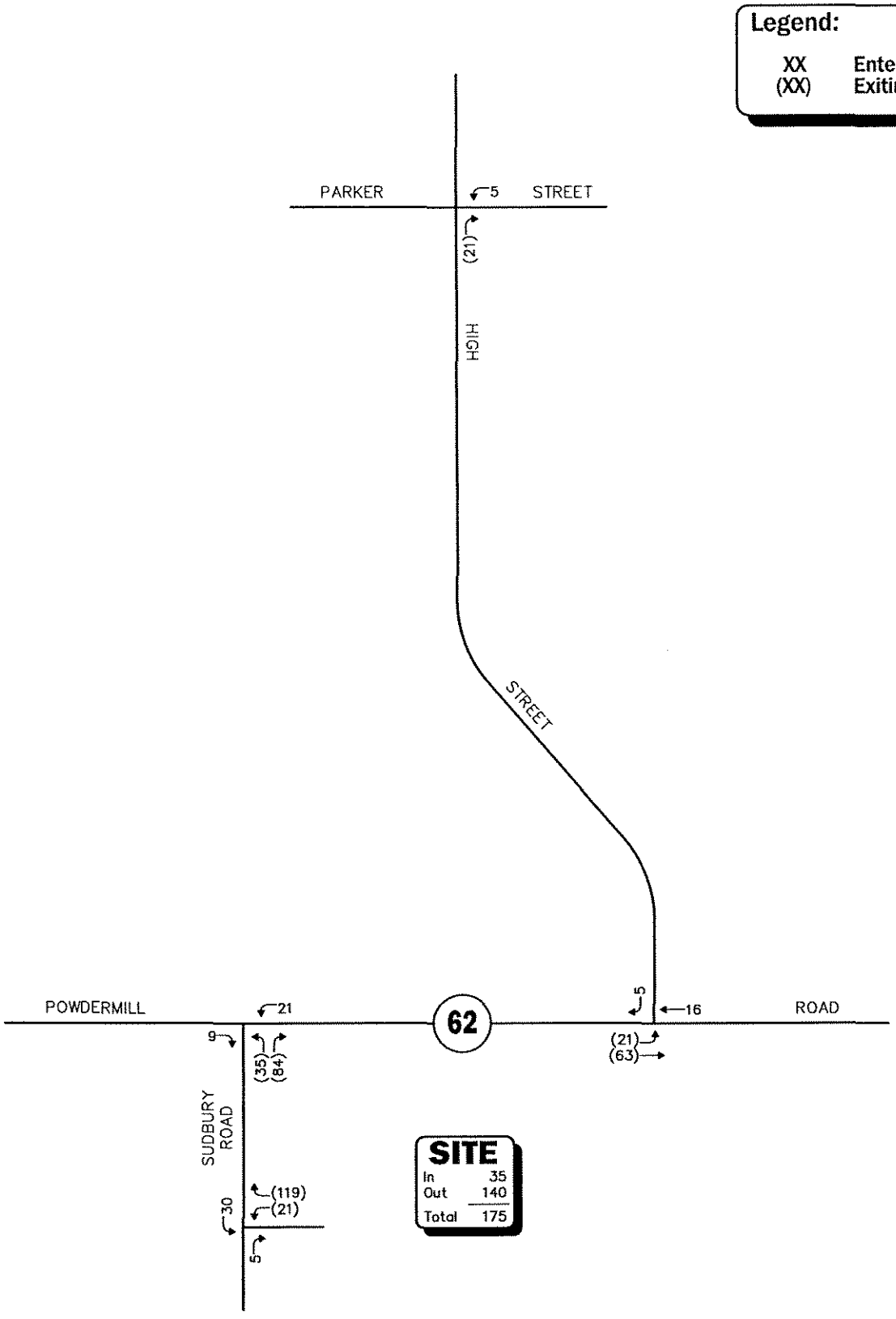

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Figure 7

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Project Generated Weekday Morning Peak Hour Traffic Volumes

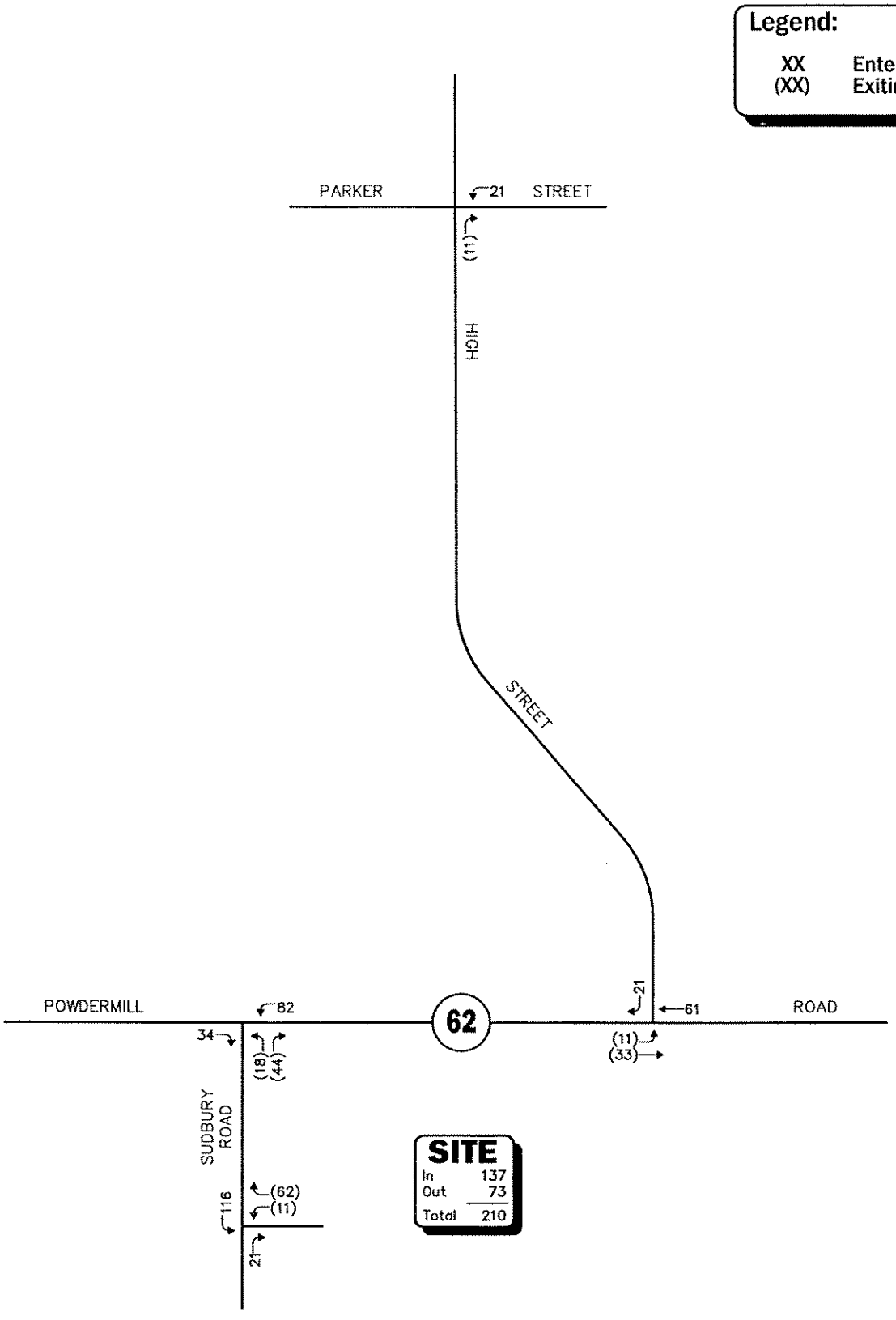

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Figure 8

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Project Generated
Weekday Evening
Peak Hour Traffic Volumes

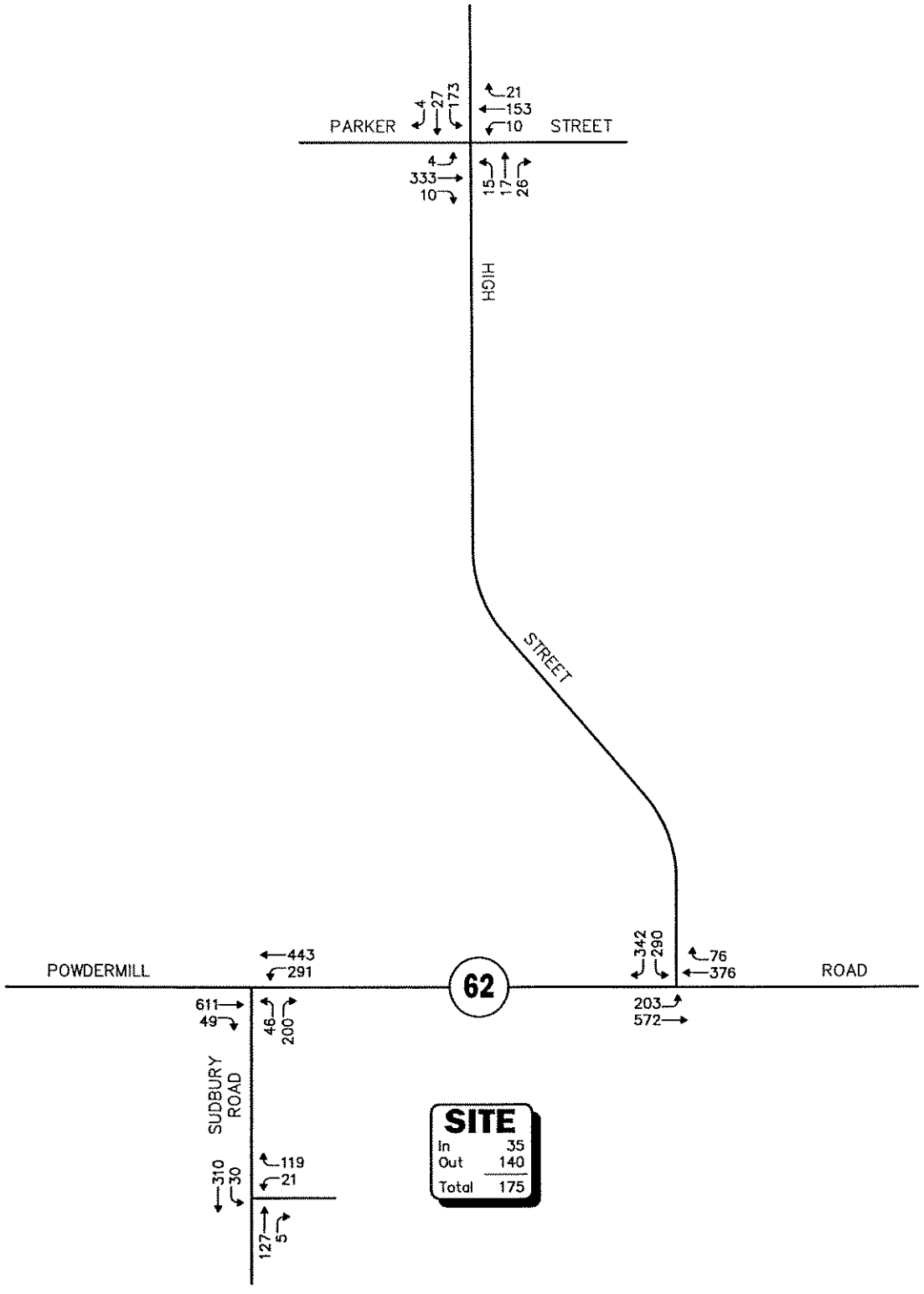

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Figure 9

2012 Build
Weekday Morning
Peak Hour Traffic Volumes

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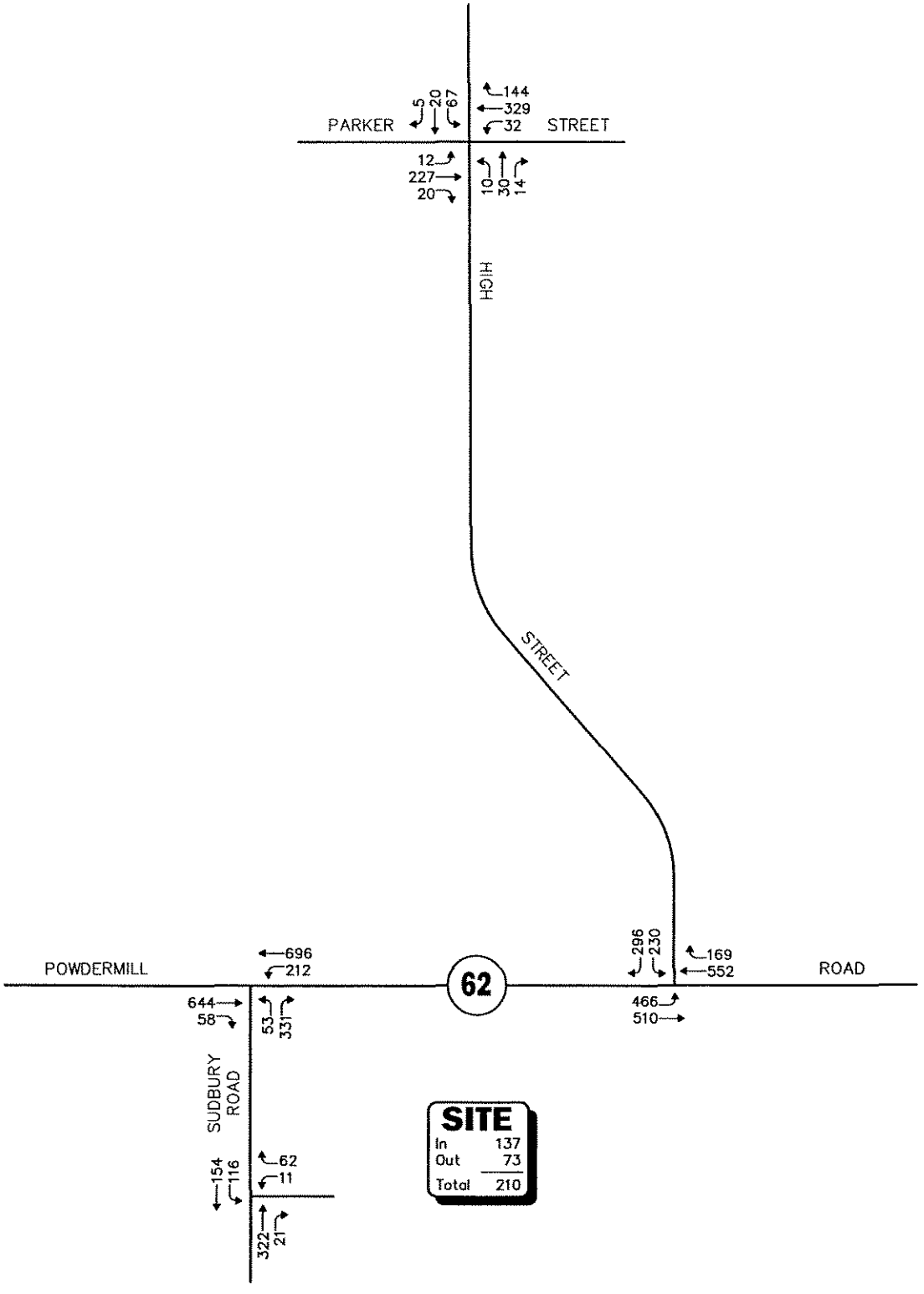

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Figure 10

2012 Build
Weekday Evening
Peak Hour Traffic Volumes

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TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

In brief, six levels of service are defined for each type of facility. They are given letter designations ranging from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions. Since the level-of-service of a traffic facility is a function of the flows placed upon it, such a facility may operate at a wide range of levels of service depending on the time of day, day of week, or period of the year. The Synchro intersection capacity analysis software, which is based on the analysis methodologies and procedures presented in the 2000 *Highway Capacity Manual* (HCM)[4] for signalized and unsignalized intersections, was used to complete the level-of-service and vehicle queue analyses.

Analysis Results

Level-of-service and vehicle queue analyses were conducted for 2006 Existing, 2012 No-Build, and 2012 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized for unsignalized and signalized intersections in Tables 5 and 6, respectively. The detailed analysis results are presented in the Appendix.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area.

Unsignalized Intersections

Route 62 at Sudbury Road

Under 2006 Existing conditions, the critical movements at this unsignalized intersection (all movements from Sudbury Road) were shown to operate at LOS D during the weekday morning peak hour and at LOS F during the weekday evening peak hour. Under 2012 No-Build conditions, the critical movements were shown to degrade to LOS E during the weekday morning peak hour as a result of traffic volume increases independent of the proposed project, and to continue to operate at LOS F during the weekday evening peak hour. Under 2012 Build conditions, with the addition of project-related traffic, the critical movements were shown to degrade to LOS F during the weekday morning peak hour and to continue to operate at LOS F during the weekday evening peak hour. Vehicle queues at the intersection were shown to range from 0 to 26+ vehicles during the peak periods. All movements along Route 62 were shown to operate at LOS A under all analysis scenarios, with minimal vehicle queuing (0 to 2 vehicles).

High Street at Parker Street

Under 2006 Existing conditions, the critical movements at this unsignalized intersection (northeastbound left-turn/through movements from Parker Street during the weekday morning peak hour and all southwestbound movements from Parker Street during the weekday evening peak hour) were shown to operate at LOS E during the weekday morning peak hour and at LOS C during the weekday evening peak hour. Under 2012 No-Build conditions, the critical movements were shown to degrade to LOS F during

[4] *Highway Capacity Manual*, Transportation Research Board; Washington, DC; 2000.

Table 5
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/Peak Hour/Movement	2006 Existing				2012 No-Build				2012 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Route 62 at Sudbury Road												
Weekday Morning:												
Route 62 NEB TH/RT	593	0.0	A	0	651	0.0	A	0	660	0.0	A	0
Route 62 SWB LT/TH	613	7.1	A	2	713	7.9	A	2	734	8.6	A	2
Sudbury Road NWB LT/RT	119	25.7	D	3	127	46.9	E	4	246	>50.0	F	26
Weekday Evening:												
Route 62 NEB TH/RT	565	0.0	A	0	668	0.0	A	0	702	0.0	A	0
Route 62 SWB LT/TH	740	3.2	A	1	826	3.9	A	1	908	6.4	A	1
Sudbury Road NWB LT/RT	303	>50.0	F	12	322	>50.0	F	23	384	>50.0	F	NC
High Street at Parker Street												
Weekday Morning:												
High Street NWB LT/TH/RT	35	3.0	A	0	37	3.0	A	0	58	2.0	A	0
High Street SEB LT/TH/RT	192	6.0	A	1	204	6.6	A	1	204	6.7	A	1
Parker Street NEB LT/TH	308	45.2	E	8	337	>50.0	F	12	337	>50.0	F	13
Parker Street NEB RT	9	0.0	A	0	10	0.0	A	0	10	0.0	A	0
Parker Street SWB LT/TH/RT	137	19.9	C	2	179	29.9	D	4	184	>50.0	F	8
Weekday Evening:												
High Street NWB LT/TH/RT	40	1.7	A	0	43	1.7	A	0	54	1.4	A	0
High Street SEB LT/TH/RT	87	5.5	A	0	92	5.6	A	0	92	5.6	A	0
Parker Street NEB LT/TH	187	15.3	C	2	239	19.7	C	4	239	20.4	C	4
Parker Street NEB RT	19	0.0	A	0	20	0.0	A	0	20	0.0	A	0
Parker Street SWB LT/TH/RT	436	24.1	C	7	484	34.9	D	10	505	>50.0	F	14
Sudbury Road at Old Powdermill Road												
Weekday Morning:												
Old Powdermill Road SWB LT/RT	--	--	--	--	--	--	--	--	140	10.5	B	1
Sudbury Road NWB TH/RT	--	--	--	--	--	--	--	--	132	0.0	A	0
Sudbury Road SEB LT/TH	--	--	--	--	--	--	--	--	340	0.9	A	0
Weekday Evening:												
Old Powdermill Road SWB LT/RT	--	--	--	--	--	--	--	--	73	12.1	B	1
Sudbury Road NWB TH/RT	--	--	--	--	--	--	--	--	343	0.0	A	0
Sudbury Road SEB LT/TH	--	--	--	--	--	--	--	--	270	4.2	A	1

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue length in vehicles.
NEB = northeastbound; SEB = southeastbound; SWB = southwestbound; NWB = northwestbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.
NC = Not calculated.

Table 6
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Signalized Intersection/Peak Hour/Movement	2006 Existing				2012 No-Build				2012 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95[th]	V/C	Delay	LOS	Queue Avg./95[th]	V/C	Delay	LOS	Queue Avg./95[th]
Route 62 at High Street												
Weekday Morning:												
Route 62 NEB LT	0.32	5.9	A	1/2	0.38	6.7	A	2/2	0.44	7.1	A	2/3
Route 62 NEB TH	0.49	7.9	A	4/6	0.55	8.7	A	5/7	0.62	9.8	A	6/9
Route 62 SWB TH	0.44	15.2	B	4/6	0.57	17.5	B	5/8	0.60	18.3	B	5/9
Route 62 SWB RT	0.05	11.4	B	0/1	0.06	11.5	B	0/1	0.06	11.7	B	0/1
High Street SEB LT	0.67	23.1	C	4/7	0.70	24.4	C	4/7	0.70	24.4	C	4/7
High Street SEB RT	0.22	8.9	A	0/2	0.31	9.4	A	1/3	0.33	9.4	A	1/3
Overall	**0.54**	**11.8**	**B**	--	**0.59**	**13.0**	**B**	--	**0.64**	**13.3**	**B**	--
Weekday Evening:												
Route 62 NEB LT	0.84	18.9	B	3/10	1.00	53.9	D	6/13	1.08	>80.0	F	7/13
Route 62 NEB TH	0.36	6.5	A	3/5	0.45	7.4	A	4/6	0.48	7.8	A	4/7
Route 62 SWB TH	0.66	20.0	B	6/9	0.76	23.9	C	7/13	0.85	29.8	C	8/15
Route 62 SWB RT	0.11	12.3	B	0/2	0.11	12.5	B	0/2	0.11	12.5	B	0/2
High Street SEB LT	0.65	22.5	C	4/5	0.67	23.3	C	4/6	0.67	23.3	C	4/6
High Street SEB RT	0.31	8.9	A	1/2	0.36	9.2	A	2/3	0.42	9.6	A	2/3
Overall	**0.76**	**15.1**	**B**	--	**0.88**	**23.3**	**C**	--	**0.93**	**29.8**	**C**	--

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in vehicles.
[e]95[th] percentile queue is metered by upstream signal.
NEB = northeastbound; SEB = southeastbound; SWB = southwestbound; NWB = northwestbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

the weekday morning peak hour and to LOS D during the weekday evening peak hour as a result of traffic volume increases independent of the proposed project. Under 2012 Build conditions, with the addition of project-related traffic, the critical movements were shown to continue to operate at LOS F during the weekday morning peak hour and to degrade to LOS F during the weekday evening peak hour. Vehicle queues at the intersection were shown to range from 0 to 14 vehicles during the peak periods. The addition of project-related traffic to this intersection was shown to result in an increase in vehicle queuing over No-Build conditions ranging from 0 to 4 vehicles during the peak periods. All movements along High Street Street were shown to operate at LOS A under all analysis scenarios, with minimal vehicle queuing (0 to 1 vehicle).

Sudbury Road at Old Powdermill Road

Under 2012 Build conditions, the critical movements at this unsignalized intersection (all movements from Old Powdermill Road) were shown to operate at LOS B during both the weekday morning and evening peak hours. Vehicle queues at the intersection were shown to range from 0 to 1 vehicle during the peak periods. All movements along Sudbury Road were shown to operate at LOS A under all analysis scenarios, with minimal vehicle queuing (0 to 1 vehicle).

Signalized Intersection

Route 62 at High Street

Under 2006 Existing conditions, this signalized intersection was shown to operate at an overall LOS B during both the weekday morning and evening peak hours. Under 2012 No-Build and 2012 Build conditions, overall operating conditions were shown to continue at LOS B during the weekday morning peak hour and to degrade to LOS C during the weekday evening peak hour as a result of traffic volume increases independent of the proposed project. Vehicle queues at the intersection were shown to range from 0 to 15 vehicles during the peak periods. The proposed project was not shown to result in a significant increase in vehicle queues at the intersection over No-Build conditions (0 to 2 vehicles during the peak periods).

SIGHT DISTANCE MEASUREMENTS

Sight distance measurements were performed at the intersection of Sudbury Road at Old Powdermill Road in accordance with MassHighway and American Association of State Highway and Transportation Officials (AASHTO)[5] standards. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO and MassHighway standards, at a minimum, sufficient SSD must be provided at an intersection. Table 7 presents the measured sight lines at the subject intersection.

[5] *A Policy on Geometric Design of Highway and Streets, Fifth Edition*; American Association of State Highway and Transportation Officials (AASHTO); 2004.

Table 7
SIGHT DISTANCE MEASUREMENTS

Intersection/Sight Distance Measurement	Required Minimum (Feet)[a]	Measured (Feet)
Sudbury Road at Old Powdermill Road		
Stopping Sight Distance:		
Sudbury Road approaching from the north	180	283
Sudbury Road approaching from the south	180	180
Intersection Sight Distance:		
Looking to the north from Old Powdermill Road	180	306
Looking to the south from Old Powdermill Road	180	230

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets, Fifth Edition*; American Association of State Highway and Transportation Officials (AASHTO); 2004, and based on a 28 mph approach speed on Sudbury Road.

As can be seen in Table 7, the measured sight lines both approaching the intersection along Sudbury Road (SSD) and for motorists exiting Old Powdermill Road (ISD) were found to meet or exceed the recommended minimum sight distance requirements for a 28 mph approach speed along Sudbury Road, consistent with the measured 85th percentile vehicle travel speed along this segment of Sudbury Road.

CONCLUSIONS

The proposed 350-unit residential apartment community is expected to generate approximately 2,254 vehicle trips on an average weekday (1,127 entering and 1,127 exiting), with approximately 175 vehicle trips (35 entering and 140 exiting) during the weekday morning peak hour and 210 vehicle trips (137 entering and 73 exiting) during the weekday evening peak hour.

An analysis of traffic operations at the study area intersections indicates that, in general, the proposed project will have a measurable but minor impact on traffic operations and vehicle queuing at the study intersections over Existing or anticipated future conditions without the project (No-Build condition). All movements at the intersection of Sudbury Road at Old Powdermill Road were shown to operate at a LOS B or better during the peak periods under all analysis conditions, with minimal vehicle queuing (0 to 1 vehicle).

RECOMMENDATIONS

Site Access

Access to the proposed residential community will be provided by way of Old Powdermill Road, a public way within the Town of Acton, which intersects the east side of Sudbury Road. It is recommended that Old Powdermill Road be reclaimed (resurfaced) and reconstructed as necessary to provide a minimum roadway cross-section of 24-feet (paved area), accommodating two-way travel, with vehicles exiting the development placed under STOP-sign control. In addition, it is recommended that Old Powdermill Road be realigned approaching Sudbury Road to form as close to a perpendicular intersection as possible. It

appears that this improvement can be completed be either shifting Old Powdermill Road to the north (west) of its current intersection with Sudbury Road (preferred) or by realigning the roadway slightly to the south (east). Shifting Old Powdermill Road to the north would result in an improvement in sight lines at the newly formed intersection and facilitate both traffic operations and turning movements to and from the development. Further, it is recommended that Sudbury Road be reconstructed to the south of Old Powdermill Road to provide a minimum roadway cross-section of 22-feet within the available public right-of-way. The current cross-section approaching Old Powdermill Road from the south is 18-feet, which is not appropriate for two-way travel given the volume of traffic accommodated by this roadway (approximately 3,990 vehicles per day). This improvement should be completed independent of the proposed project. In addition, it is suggested that a pedestrian connection between the project and Route 62 be developed.

Any signs or landscaping adjacent to the intersection of Old Powdermill Road with Sudbury Road and within the community should be designed and maintained so as not to restrict sight lines of sight to or from intersecting roadways. If centerline pavement markings are provided along Sudbury Road, Old Powdermill Road or the roadways within the site, they should consist of a double-yellow line in accordance with the centerline pavement marking standards of the Manual on Uniform Traffic Control Devices (MUTCD).[6]

Off-Site

Route 62 at Sudbury Road

An analysis of traffic operations at this unsignalized intersection indicates that all movements from Sudbury Road during the weekday evening peak hour are currently operating over capacity (LOS F), independent of the proposed project. Absent improvement, operating conditions at this intersection are expected to further degrade in the future, again independent of the proposed project. A review of the peak-hour traffic signal warrant (Warrant 3) presented in the MUTCD indicates that the installation of a traffic control signal in order to improve operating conditions at the intersection may be warranted under 2006 Existing conditions during the weekday evening peak hour, again, independent of the proposed project. Recognizing the importance of this intersection in providing access to the project and the residences and businesses in the area, it is recommended that the following improvements be offered at the intersection of Route 62 at Sudbury Road:

1. Complete a detailed Traffic Signal Warrants Analysis (TSWA) in accordance with the methodology established in the MUTCD;
2. If the installation of a traffic control signal is found to be warranted, prepare a Functional Design Report (FDR), MassHighway 25 Percent Design Plans and a MassHighway Project Need Form (PNF) for Town use in obtaining funding from MassHighway for the completion of improvements to the intersection; and
3. Subject to the approval of the PNF by MassHighway, provide funding to the Town for the completion of the required design plans and partial funding for construction based on the project's overall impact on operating conditions at the intersection as measured by the percent increase in traffic attributable to the project over No-Build conditions.

With the installation of a traffic control signal at the intersection, overall operating conditions were shown to improve to LOS C during both the weekday morning and evening peak hours under 2012 Build with Mitigation conditions.

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[6] *Manual on Uniform Traffic Control Devices* (MUTCD); Federal Highway Administration; Washington, DC; 2003.

Independent of the proposed project, it is recommended that double-yellow centerline pavement markings be provided along Sudbury Road approaching Route 62 for a minimum distance of 100 feet in advanced of the STOP-line.

Route 62 at High Street

Overall operating conditions at the signalized intersection of Route 62 at High Street were found to be acceptable (LOS C or better) under all three analysis conditions; however, left-turn movements from Route 62 northbound were found to become constrained (LOS F) during the weekday evening peak hour with the addition of project-related traffic. In order to improve operating conditions at this intersection and off-set the potential impact of the project, it is recommended that an optimal traffic signal timing and phasing plan be designed and implemented for the intersection within one-year of the issuance of the final Certificate of Occupancy for the project.

High Street at Parker Street

The proposed project was not shown to have a significant impact on traffic operations at this unsignalized intersection. However, the intersection was found to have a motor vehicle crash rate that exceeded the MassHighway District 4 average for unsignalized intersections. As such and recognizing the relatively minor impact of the project at this intersection, it is recommended that a detailed safety analysis of the intersection be undertaken based on motor vehicle crash data provided by the Town of Acton Police Department for the most recent three-year period available, including the preparation of a motor vehicle collision diagram, in order to identify any safety deficiencies that may exist at the intersection that are subject to correction. It is envisioned that these improvements would be completed in conjunction with the project and would include the installation and replacement of signs and pavement markings at and in advance of the intersection, and sight line improvements limited to vegetation maintenance and/or removal within the public right-of-way.

With implementation of the above recommendations, safe and efficient access will be provided to the planned development and the proposed project can be constructed with minimal impact on the roadway system.

cc: D. Horwitz, Esquire – Goulston and Storrs
RDV, BG, MS, File